

**REMARKS**

Initially, applicants would like to note that a replacement Information Disclosure Statement (IDS) replacing the IDS of January 3, 2002, was submitted on June 26, 2003 and is believed to comply with 37 CFR 1.98(b), 37 CFR 1.98 (a)(1) and 37 CFR 1.98 (a)(2). Consideration of the Information Disclosure Statement is respectfully requested.

Replacement drawing figures are submitted and believed to address the drawing objections noted in the Official Action.

The specification has been amended to make editorial changes, including those noted in the Official Action, to place the application in condition for allowance at the time of the next Official Action.

Claims 71-80 were previously pending in the application. Claims 121-128 have been added. The new claims are believed to address the 35 USC §112, first paragraph and 35 USC §112, second paragraph rejections noted in the Official Action.

The applicants have also amended claims 71, 75 and 76, and canceled claims 72-74, while having other elected claims 77-80 remain unchanged from the originals, in order to place the application in condition for allowance at the time of the next Official Action. New dependent claim 121 is added which depends from claim 71. New claim 121 is supported by the descriptions on page 50, lines 12-15 of the specification.

All of the recitations of claims 72-74 are incorporated into claim 71. Claim 75 originally dependent from claim 74 has been amended to depend upon the amended claim 71.

The specification as filed discloses a first type of semiconductor device for low output performance, which is recited in claims 1-60 and shown, by way of example in Figures 14 and 15.

The specification as filed also discloses a second type of semiconductor device for high output performance, which is recited in the claims 61-120 and shown by way of example in Figures 16 and 17.

The previously-elected claims 71-80 are directed to the second type semiconductor device for high output performance.

Applicants have amended claim 71 to recite standard deviations of microscopic and macroscopic fluctuations, but not to include the optional feature of the undoped GaN optical confinement layer, because the focus of the claims is more on the improved fluorescent layer included in the active layer, and less on the other layers. Notwithstanding, an optional and preferable feature of the present invention includes the undoped GaN optical confinement layer.

Claim 71 as amended herewith also defines the relationship between the luminescent layer and the quantum well, but does not recite a particular set of materials for the respective elements constituting the semiconductor device,

because the selection of those materials may vary and is not essential for the present invention, provided that the material of the luminescent layer is as defined in the claim.

Support for these amendments appears for example in the original specification on page 31, the last paragraph, the descriptions on page 32, the first paragraph, and the descriptions on page 32, the last incomplete paragraph to page 33, the first incomplete paragraph, the descriptions on page 33, the first complete paragraph, the descriptions on page 34, the first complete paragraph, the descriptions on page 34, the second complete paragraph, the descriptions on page 35, the first complete paragraph, the descriptions on page 36, the first complete paragraph, the descriptions on page 36, the second complete paragraph, the descriptions on page 36, the second complete paragraph, the descriptions on page 37, the second complete paragraph, the descriptions on page 43, the first complete paragraph, the descriptions on page 43, the second complete paragraph, the descriptions on page 76, lines 16-17, the descriptions on page 50, lines 12-15, the descriptions on page 51, lines 19-24, the descriptions on page 57, the first complete paragraph, and the descriptions on page 57, the first complete paragraph, as well as shown in Figures 10 and 16.

From the descriptions of the present invention made in the above-designated parts of the original specification, it is

apparent that the invention seeks to reduce not only the macroscopic fluctuation but also the microscopic fluctuation of the indium composition of the fluorescent layer included in the active layer. Notwithstanding, improvements in the layers other than the fluorescent layer are within the scope of the present invention.

The reductions in the microscopic fluctuation of the indium composition of the fluorescent layer causes the reduction in the band gap energy of the fluorescent layer. This is apparent from the descriptions of the present invention made in the above-designated parts of the original specification.

Further, claim 76 has been amended to define the luminescent layer, for which the photo-luminescence peak wavelength distribution is measured. The specification on page 34, lines 14-16, describes that the "microscopic fluctuation" is represented by a measured photo-luminescence peak wavelength distribution. Since the "microscopic fluctuation" is related to the luminescent layer, the "photo-luminescence peak wavelength distribution" is related to the luminescent layer.

The applicants have also amended claim 71 to add second, third and fifth conditions, recited in original claims 72-74, to the first and fourth conditions, recited in original claim 71. The first, second and third conditions defined in amended claim 71 are related to each other. The fourth and fifth

conditions defined in amended claim 71 are also related to each other. If one of the first, second and third conditions is satisfied, then this means that in practice the remaining two of the first, second and third conditions may also be satisfied. Similarly, if one of the fourth and fifth conditions is satisfied, then this means that in practice the other condition may also be satisfied.

The relationship between the fourth and fifth conditions recited in amended claim 71 is based on FIG. 10 and the descriptions on page 51, lines 7-24.

The relationship between the first and second conditions recited in amended claim 71 is based on the descriptions on page 48, lines 6-14. The relationship between the first and third conditions recited in amended claim 71 is based on the descriptions on page 48, line 21 to page 49, line 11.

It is believed that amended claims 71 and 76 as amended satisfy the requirements of the first and second paragraphs of 35 U.S.C. 112.

The applicants respectfully traverse the rejections under 35 U.S.C. 102 and 103 for the following reasons. Reconsideration and withdrawal of the rejections are respectfully requested because the references do not disclose or teach satisfaction of at least one of the first to third claim conditions in combination with at least one of the fourth and

fifth claim conditions, derived from the range of the microscopic fluctuation.

From the descriptions of the present invention made in the above-designated parts of the original specification, the suppression of the "microscopic fluctuation" of the band gap energy or of the indium composition profile of the luminescent layer is significant for those embodiments of the present invention related to the second type semiconductor device for low output performance.

The description on page 59, lines 14-16, describes that the "microscopic fluctuation" of the potential energy or the band gap energy is provided by the "microscopic fluctuation" of the indium composition profile.

Further, the description on page 50, lines 12-15, for an embodiment of the second type semiconductor device for low output performance, describes that the standard deviation " $\sigma_g$ " in the "microscopic fluctuation" of the energy band gap is not more than 40 meV means that the standard deviation " $\Delta_x$ " in the "microscopic fluctuation" of the indium composition is not more than 0.067.

The fifth condition, that the standard deviation " $\sigma_g$ " in the "microscopic fluctuation" of the energy band gap is not more than 40 meV, is significant for those embodiments of the

second type semiconductor device for low output performance, provided that the fourth condition of the differential gain recited in amended claim 71 is related to the fifth condition.

Amended claim 71 requires satisfaction of both at least one of the first to third conditions and at least one of the fourth and fifth conditions. This recitation that the luminescent layer of  $\text{In}_x\text{Al}_y\text{Ga}_{1-x-y}\text{N}$  ( $0 < x < 1$ ,  $0 \leq y \leq 0.2$ ) has a limited range, that the standard deviation " $\sigma_g$ " in the "microscopic fluctuation" of the energy band gap is not more than 40 meV, or a related limited range wherein the standard deviation " $\Delta_x$ " in the "microscopic fluctuation" of the indium composition is not more than 0.067.

Page 32, lines 8-13 describes that the "macroscopic fluctuation" is measurable by a micro-photo-luminescence measurement method with a beam spot diameter of not less than 1 micrometer. The "microscopic fluctuation" is difficult to measure by a photo-luminescence measurement method with a beam spot diameter of not less than 1 micrometer.

Page 58, lines 12-14, describes that the "microscopic fluctuation" is measured from the dependency on the photo-luminescence life-time. The descriptions for the measured photo-luminescence life-time follows with reference to FIG. 11.

USP 6,555,403 issued to DOMEN et al. has three foreign priority applications JP 9-204364, JP 9-213672, and JP 9-263158. Japanese patent application No. 10-215147 was filed by claiming the domestic priorities of the above three priority JP applications and then laid-open under Japanese laid-open patent publication No. 11-340580, which is referred to as the applicants' admitted prior art, on page 34, at the bottom line. The description on page 34, line 19, to page 35, line 3, reveals that, in the context of the prior art, the term fluctuation generally means the "macroscopic fluctuation" which is measurable by the photo-luminescence measurement, namely the fluctuation in the 1-micrometer scale order of magnitude, because the micro-photo-luminescence measurement is made with the beam spot diameter of not less than 1 micrometer. In Japanese laid-open patent publication No. 11-340580, the described fluctuation is the "macroscopic fluctuation", and this document was directed to reducing the "macroscopic fluctuation" for preventing laser emissions at multiple wavelengths.

The present specification at page 36, lines 1-20 teaches that:

"In the past, there had been no investigation on control of the "microscopic fluctuations" in the microscopic scale nor report about any influence of the "microscopic fluctuations" to the device performances. There had not been known any certain or available method of how to reduce the "microscopic fluctuations" in the microscopic scale. As disclosed in Japanese

laid-open patent publication No. 11-340580, it had been known that the "macroscopic fluctuations" in the macroscopic scale is reducible by reducing the dislocation density of the substrate and adjusting the growth rate of the active layer. The reductions of the "microscopic fluctuations" are not obtained by those conventional methods. The present invention was established by drawing the attention to the "microscopic fluctuations" which had never been considered in the prior art. The present invention was realized by the reductions in the "microscopic fluctuations" in the compositional profile and the band gap energy profile of the active layer in the microscopic scale, and also by keeping a desirable high differential gain if the semiconductor device is applied to the laser diode. Those reductions in the "microscopic fluctuations" provide the effects that the local strain in the luminescent layer included in the active layer is controlled to reduce a threshold current of the laser."

The specification on page 8, lines 5-9, describes that Japanese laid-open patent publication No. 11-340580 discloses to control the indium compositional fluctuation, wherein the compositional uniformity is improved to prevent the multi-wavelength laser emission. The compositional uniformity is measurable from the photo-luminescence peak wavelength distribution.

DOMEN et al. do not disclose nor teach the concept of "microscopic fluctuation" on the order of one micron. DOMEN et al. do not disclose nor teach the measurement of the photo-luminescence life-time.

Accordingly, it is reasonable that the scale of the fluctuation addressed by DOMEN et al. is just the "macroscopic

fluctuation", measurable by the photo-luminescence peak wavelength distribution.

The control or suppression of the "microscopic fluctuation" in the energy band gap or the indium composition permits satisfying both (a) at least one of the first to third conditions and (b) at least one of the fourth and fifth conditions. This is supported throughout the specification as noted above.

It therefore does not appear that fluctuation addressed by DOMEN et al. is the "microscopic fluctuation". Accordingly, the anticipation rejection is believed to be improper. Reconsideration and withdrawal of the rejection are respectfully requested.

Claims 74, 75, 78, and 80 were rejected as unpatentable over DOMEN et al. in view of RAZEGHI 6,459,096 and applicants' disclosed prior art. This rejection is also respectfully traversed.

Claims 74, 75, 78 and 80 are rewritten as claims 122, 123, 126, and 128, respectively. Claims 122, 123, 126, and 128 depend from claim 121 and further define the invention. As set forth above, DOMEN et al. do not disclose or suggest what is recited in claim 121. Neither RAZEGHI nor the disclosed prior art teach or suggest what is recited in claim 121. Accordingly, the

proposed combination of references would not render obvious claims 122, 123, 126, and 128 of the present application.

In addition, claim 123 recites that the semiconductor device has a cavity length of not less than 1000 micrometers.

The Official Action offers RAZEGHI as teaching cavity lengths from 700 micron to 1800 micrometer and contends that it would have been obvious to incorporate the teachings of RAZEGHI into the device of DOMEN et al. to reduce threshold current density.

However, as noted at column 29, lines 3 and 4, and column 30, lines 66 and 67 of DOMEN et al., for example, the resonator length of DOMEN is 700 micrometer. Each of the examples of DOMEN et al. teach a resonator length of 700 micrometer.

MPEP §2143.01 states that if the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie* obvious. *In re Ratti*, 270 F.2d 810, 123 USPQ 349 (CCPA 1959).

DOMEN et al. is controlling the threshold current density by changing a thickness of the active layer, as disclosed at column 26, lines 23-34. Changing the cavity length as suggested in the Official Action to control the threshold current density would change the principal of operation of DOMEN et al.,

and thus the teachings of RAZEGHI are not sufficient to render the claims *prima facie* obvious.

Accordingly, it is believed that the new claims avoid the rejection under §103 and are allowable over the art of record.

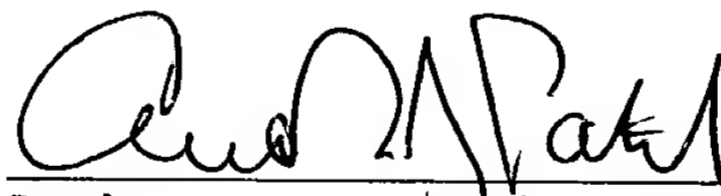
In view of the present amendment and the foregoing remarks, it is believed that the present application has been placed in condition for allowance. Reconsideration and allowance are respectfully requested.

Should there be any matters that need to be resolved in the present application, the Examiner is respectfully requested to contact the undersigned at the telephone number listed below.

The Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 25-0120 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17.

Respectfully submitted,

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**APPENDIX:**

The Appendix includes the following items:

- Replacement Sheets for Figures 1-18 of the drawings